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ance of certain forms of skeletal structures. And I am able to add that in the markings of animals—*e.g.*, butterflies—characters everywhere degenerate whose present or former use cannot be discerned, which we must regard as non-essential.

"Weismann supposes that even in those cases in which adaptation is not demonstrated it is really present. But such an assumption belongs to the domain of faith.

"We ought, on the contrary, to say: We know that definite stimuli must produce an effect on or in the organism; that they must give rise to definite changes of form, definite character, whether these be useful to the organism or not.

"When we maintain this we take our stand, not on mere assumptions, but on physiological facts. Normal physiology and pathology in like measure speak for us with the weight of all their fundamental truths.

"Thus there is certainly a physiological basis for the belief that the above-described variations of the sponge-skeleton are simply to be ascribed to changes of external, *i.e.*, of nutritive conditions, of the material composition of the body."

The translator has performed an excellent service. We cannot but agree with him in some remarks in his preface as to the editorial conduct of the English periodical *Nature*. He complains of the exclusion of articles which do not coincide with the views of the editor of the department of Natural History. On this we observe that such exclusions, no doubt, often occur, but though it may not be commended as judicial, it is within editorial right. But mutilation or alteration of articles, as is sometimes practiced by that periodical, is clearly not within editorial right, and to this practice exception may be still more fairly taken.—*E. D. Cope.*

Geddes and Thompson on the Evolution of Sex.[1]—In this book we have a systematic *résumé* of what is known on the subject of sex, with inferences which appear to the authors reasonably to flow from the facts. The work is divided into four "books," viz.: I. Male and Female; II. Analysis of Sex,—organs, tissues, cells; III. Processes of Reproduction; IV. Theory of Reproduction. The work done in this direction has been very large in the last few years, and the time was ripe for the presentation to the public of just such a work as the present. The subject is not only intrinsically interesting, but it has the closest relation to the general question of evolution. Further, the essential nature of sex-character has the greatest practical bearing on human affairs, and its thorough comprehension cannot fail to be of great utility to society. In fact, such knowledge is the one thing needful to regulate the unbridled fancies of the uneducated mind which attempts to deal with the subject, and which has produced innumerable absurdities since the human imagination began to be active.

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[1] The Evolution of Sex. By Prof. Patrick Geddes and J. Arthur Thompson. 8vo, pp. 322. From the Contemporary Science Series. London: Walter Scott.

The authors have produced a book which has not only scientific but literary merits, and many of its bright passages indicate the artist as well as the thinker. The more delicate parts of the subject are handled with a tact that cannot give offence to persons of most opposite views, ; and a judicious reserve is maintained in the presence of unsolved social problems, with the discussion of which the volume closes.

The fundamental character of sex-diversity is demonstrated, and is traced in the characteristic peculiarities of the germ-cells of the sexes, as at present existing. The superior activity of the male cell (spermatozoöid), with its expenditure of energy in segmentation so long as material for its nutrition is accessible, is taken as reflected into the male character generally. The large, inactive female cell (ovum), abounding in nutritive material, which is ready for active functioning on the accession of male energy, is thought to be reflected more or less in the general habit of the female. The facts in evidence which sustain this position are as numerous as are the phenomena of life, and a large number of them are recorded in the present work. The views of the authors are more expressly stated in the following extracts:

"Without multiplying instances, a review of the animal kingdom, or a perusal of Darwin's pages, will amply confirm the conclusion that on an average the females incline to passivity, the males to activity. In higher animals it is true that the contrast shows rather in many little ways than in any one striking difference of of habit, but even in the human species the contrast is recognized. Every one will admit that strenuous, spasmodic bursts of activity characterizes men, especially in youth, and among the less civilized races; while patient continuance, with less violent expenditure of energy, is as generally associated with the work of women.

"For completeness of argument two other facts, which will afterwards claim full discussion, may here be simply mentioned: (*a*). At the very threshold of sex-differences we find that a little active cell or spore, unable to develop of itself, unites in fatigue with a larger, more quiescent individual. Here, at the very first, is the contrast between male and female. (*b*). The same anthithesis is seen when we contrast, as we shall afterwards do in detail, the actively motile, minute male element of most animals and many plants with the larger, passively quiescent female cell or ovum.

"While it is easy to point to the general physiological import of large size and the reverse, physiology is not yet far enough advanced to afford firm foot-hold in dealing with the details of secondary sexual characters. It is only possible to point out the path which will eventually lead us to their complete rationale. This path will appear less vague if reverted to after some of the succeeding chapters have been grasped. The point of view is simple enough. The agility of males is not a special adaptation to enable that sex to exercise its functions with relation to the other, but is a natural characteristic of the constitutional activity of maleness; and the small size of many male fishes is not an advantage at all, but simply again the result of the contrast between the more vegetative growth of the female, and the costly activity of the male. So, brilliancy of color, exuberance of hair and feathers, activity of scent-glands, and even the development of weapons, are not, and cannot be (except teleologically), explained by natural selection, but in origin and continued development are outcrops of a male as opposed to a female constitution. To sum up the position in a paradox, all secondary sexual characters are at bottom primary, and are expressions of the same general habit of body (or to use a medical term, *diathesis*), as that which results in the production of male elements in the one case, or female elements in the other.

"Three well-known facts must be recalled to the reader's mind at this point; and firstly, that in a great number of cases the secondary sexual characters make their appearance step by step with sexual maturity itself. When the animal, be it bird or insect, becomes emphatically masculine, then it is that these minor out-crops are exhibited. Thus the male bird of paradise, eventually so resplendent, is usually in its youth comparatively dull and female-like in its coloring and plumage. Very often, too, whether in the wedding-robes of male fishes or in the scent-glands of mammals, the character rises and wanes in the same rhythm as that of the reproductive periods. It is impossible not to regard at least many of the secondary sexual characters as part and parcel of the sexual diathesis,—as expressions, for the most part of exuberant maleness. Secondly, when the reproductive organs are removed by castration, the secondary characters tend to remain undeveloped. Thus, as Darwin notes, stags never renew their antlers after castration, though normally of course they renew them each breeding season. The reindeer, where the horns occur on the female as well, is an interesting exception to the rule, for after castration the male still renews the growth. This, however, merely indicates that the originally sexual characters have become organized into the general life of the body. In sheep, antelopes, oxen, etc., castration modifies or reduces the horns; and the same is true of odoriferous glands. The parasitic Crustacean Sacculina has been shown by Delage to effect a partial castration of the crabs to which it fixes itself, and the same has been observed by Giard in other cases. In two such cases an approximation to the female form of appendage has been observed. Lastly, in aged females, which have ceased to be functional in reproduction, the minor peculiarities of their sex often disappear, and they become liker males, both in structure and habits,—witness the familiar case of 'crowing hens.'

"From the presupposition, then, of the intimate connection between the sexuality and the secondary characters (which is indeed everywhere allowed), it is possible to advance a step further. Thus in regard to color, that the male is usually brighter than the female is an acknowledged fact. But pigments of many kinds are physiologically regarded as of the nature of waste products. Such, for instance, is the guanin, so abundant on the skin of fishes and some other animals. Abundance of such pigments, and richness of variety in related series, point to preëminent activity of chemical processes in the animals that possess them. Technically expressed, abundant pigments are expressions of intense metabolism. But predominant activity has been already seen to be characteristic of the male sex; these bright colors, then, are often natural to maleness. In a literal sense animals put on beauty for ashes, and the males more so because they are males, and not primarily for any other reason whatever.

"We are well aware that, in spite of the researches of Krukenberg, Sorby, MacMunn, and others, our knowledge of the pigments is still very scanty. Yet in many cases, alike among plants and animals, pigments are expressions of disruptive processes, and are of the nature of waste products, and this general fact is at present sufficient for our contention, that bright coloring or rich pigmenting is commonly a natural expression of the male constitution. For the red pigment so abundant in the female cochineal insect, which appears to be of the nature of a reserve and not a waste product, and for similar occurrences, due exception must be made.

"In the same way, the skin-eruptions of male fishes at the spawning season seem more pathological than decorative, and may be directly connected with sexual excitement. One instance of a way in which the reproductive maturity is known to effect a by no means obviously related result may be given. Every field-naturalist knows that the male stickleback builds a nest among the weeds, and that he weaves the material together by mucous threads secreted by the kidneys. The little animal is also known to have strong passions; it is polygamous in relation to its mates, and most pugnacious in relation to its rivals. Professor Möbius has shown that the male reproductive organs (or testes) become very large at the breeding season, and that they press in an abnormal way upon the kidneys. This encroachment produces a pathological condition in the kidneys, and the result is the formation of a mucous secretion, somewhat similar to what occurs in renal disease in higher forms. To free itself from the irritant pressure of this secretion the male rubs itself against external objects, most conveniently upon its nest. Thus the curious weaving instinct does not demand nor find rationale in the cumulative action of natural selection upon an inexplicable variation, but is traced back to a pathological and mechanical origin in the emphatic maleness of the organism. The line of variation being thus given, it is of course conceivable that natural selection may have accelerated it.

"So, too, though again the physiological details are scanty, the superabundant growth of hair and feathers may be interpreted, in some measure, through getting rid of waste products, for we shall see later how local katabolism favors cell multiplication. Combs, wattles, and skin excresences point to a predominance of circulation in the skin of the feverish males, whose temperatures are known in some cases to be decidedly higher than those of females. Even skeletal weapons like antlers may be similarly interpreted; while the exaggerated activity of the scent-glands is another expedient for excreting waste.

"In regard to horns, feathers, and the like, in association with vigorous circulation, two sentences from Rolph may be quoted: 'The exceedingly abundant circulation which periodically occurs in the at first soft frontal protuberances of stags admits and conditions the colossal development of horn and ensheathing velvet. . . . In the same way the rich flow of blood in the feather papillæ conditions the immense growth of the feathers, . . . and the same is true of hairs, spines, and teeth.'

"Some of the even subtler differences between the sexes are of interest in illustrating the general antithesis. Thus in the love-lights of the Italian glow insect (Luciola) the color is said to be identical in the two sexes, and the intensity is much the same. That of the female, however, who is in other respects rather male-like in her amatory emotions, is more restricted. It is interesting further to notice that the rhythm of the light in the male is more rapid, and the flashes are briefer, while that of the female is longer, and the flashes more distant and tremulous. This illustration may thus serve, in conclusion, as a literally illumined index of the contrasted physiology of the sexes.

"We are now in a better position to criticize Mr. Darwin's theory. On his view, males are stronger, handsomer, or more emotional, because ancestral forms happened to become so in a slight degree. In other words, the reward of breeding success gradually perpetuated and perfected a casual advantage. According to the present view, males are stronger, handsomer, or more emotional, simply because they are males,—*i. e.*, of more active physiological habit than their mates. In phraseology which will presently become more intelligible and concrete, the males live at a loss, are more *katabolic*,—disruptive changes tending to predominate in the sum of changes in their living matter or protoplasm. The females, on the other hand, live at a profit, are more *anabolic*,—constructive processes predominating in their life, whence, indeed, the capacity of bearing offspring."

Thus it is evident that the authors of the present work hold the tenets of the Neo-Lamarkians in maintaining the direct influence of physical causes as producing variation, and in the belief that acquired characters are inherited. The reasons for the adoption of these views are often stated, and with a good deal of force. The reasons why promiscuous variation and natural selection are inadequate to explain evolution, are also clearly set forth.

In the last chapter the question of population raised by Malthus is considered. Writing in a country which is, so long as the unequal distribution of land continues, fully populated, the authors admit the necessity for some method of restraining the increase of families. They consider the propositions of the Neo-Malthusians for limiting the increase by various artificial measures, and decide in favor of a different course. They observe: "It seems to us, however, essential to recognize that the ideal to be sought after is not merely a controlled rate of increase, but regulated married lives. Neo-Malthusianism might secure the former by its more or less mechanical methods, and there is no doubt that a limitation of the family would often increase the happiness of the home; but there is danger lest, in removing its result, sexual intemperance become increasingly organic. We would urge, in fact, the necessity of an ethical rather than a mechanical 'prudence after marriage;' of a temperance recognized to be as binding on husband and wife as chastity on the unmarried. . . . We need a new ethic of the sexes; and this not merely or even mainly as an intellectual construction, but as a discipline of life; and we need more. We need an increasing education and civism of women,—in fact, an economic of the sexes very different from that nowadays so common, which, while attacking the old coöperation of men and women because of its manifest imperfections, but offers us an unlimited and far more mutually destructive industrial competition between them instead. . . . And while our biological studies of course for the most part only point the way towards deeper social ones, they afford also one luminous principle toward their prosecution,—that thorough parallelism and coincidence of psychical and material considerations, upon which moralist and economist have been too much wont to specialize."

The authors do not state clearly what their "new ethic" is to be, excepting that it is to be based on a thorough recognition of the basis of biologic fact which underlies the problem. They are evidently not in sympathy with the entrance of women into either industrial or political competition with men, nor do they see in the present position of woman anything more than the natural outcome of natural evolution. "Instead of men and women merely laboring to produce things, as the past economic theories insisted, or competing over the distribution of them, as we at present think so important, a further swing of economic theory will lead us round upon a higher spiral to the direct organic facts. So it is not for the sake of production or distribution, of self-interest or mechanism, or any other idol of the economists that the male organism organizes the climax of his life's struggle and labor, but for his mate; as she, and therefore he, also, for their little ones. Production is for consumption; the species is its own highest, its sole essential product. The social order will clear itself as it comes more in touch with biology."